Disorganization due to Forbearance of Debt Restructuring*

(Incomplete and Preliminary)

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Abstract

This paper proposes a simple model of persistent stagnation due to the forbearance of restructuring corporate-debt overhang (Debt Forbearance). The purpose of this model is to explain the disappointing performance of the Japanese economy in the 1990s, and to point out the macroeconomic inefficiency possibly caused by the forbearance of corporate-debt restructuring in ordinary business cycles.

The story goes as follows. If the defaults are due to a macroeconomic financial shock, creditors may hesitate to invoke bankruptcy on debtors since the defaults are not due to debtors' faults or moral hazard. However, once a creditor rationally decides to forbear punishing a defaulter, the trading partners may distrust the defaulter's commitment to the "relation-specific" investments since the creditor may invoke bankruptcy on the debtor at any time. If suspicion prevails, chains of production by specialized suppliers are broken down, and output and productivity fall.

Additionally, we examined this "disorganization" using the Input-Output Tables of Japan. The empirical evidence suggests that disorganization occurred only after the asset-price bubble burst and the forbearance policy was chosen at the beginning of the 1990s.

1 Introduction

The last decade of the twentieth century is often described as "the Lost Decade" for the Japanese economy. The average rate of annual growth of

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the real GDP was only 0.2 % in the period of 1991-1999 except for 1995 and 1996, while it was 4.0% in the 1980s. Conventional wisdom is that the delay of the disposal of non-performing loans, which reportedly mount up to more than 20% of the GDP, has caused the persistent stagnation in Japan. See Hoshi and Kashyap [1999] for several estimates on the size of the bad loans problem in Japan. Figure 1 shows the collapse of land prices and stock prices in Japan. Bad loans have mushroomed as asset prices declined. It is because banks had lent money, in the late 1980s, based almost entirely on the value of borrowers' land and stocks. We should note the unique fact that land prices are still declining in 2000, nine years after the asset-price bubble collapsed.

Figure 1: Land Prices and Stock Prices (indices)

Since the policy-makers did not recognize that the non-performing loan problem might cause shrinkage of the real output, it is embarassing for them that the Japanese economy has not recovered despite the extraordinary monetary and fiscal expansions. The short-term rate of interest has been kept at nearly 0% for more than five years from 1995 and there have been successive fiscal expansions resulting in the huge public debt, which has been growing at an increasing speed, from 60% of the GDP in 1990 to 120% at the end of 1999.

The big puzzle is that existing economic theory is not likely to predict that the postponement of the disposal of bad loans causes a persistent stagnation of the economy.

We present a simple model in which the forbearance of restructuring corporate-debt overhang (Debt Forbearance) creates multiple equilibria, in one of which the output falls due to the external diseconomy: "disorganization."

The focus of the argument is the bargaining problems due to "incomplete contracts" and "highly specific relations" between firms in the supply network. The importance of "specificity" in macroeconomics is pointed out by Caballero and Hammour (1996) and is applied in a recent macroeconomic study of the former Soviet countries by Blanchard and Kremer (1997). According to Blanchard and Kremer, a relationship is called "specific" if there is a joint surplus to the parties from dealing with each other rather than taking their next best course of action. One example of a specific relationship is "keiretsu"(Japanese corporate group) between a major car-maker and its specialized suppliers. In a keiretsu-network, a supplier makes huge firm-specific investments which become sunk costs if it stops supplying to the car-maker.

Our story goes as follows. Under the normal circumstances, the capital structure of debt and equity guarantees that the owners of firms (shareholders) will always honor the commitments of the specific relationships with trading partners. The complex chains of production operate smoothly. Suppose that a large-scale financial shock occurs and that it makes many firms default. Then creditors obtain corporate control of the defaulters. Corporate control typically means the right to invoke bankruptcy. However, the creditors may hesitate to invoke bankruptcy on the firms, since the firms are not fully responsible for their defaults. If a creditor decides not to bankrupt the defaulter, the firm is kept operating. However, the transfer of corporate control makes the creditor the decision-maker concerning the firm's commitment to the specific relationship.

It is shown that the creditor's new payoff does not guarantee that the creditor will keep the commitment to the specific relationship. Thus, the trading partners of the firm suspect that the creditor may cancel the commitment of the firm to the production chain with them (trading partners) at any time. Then the other firms in the production chain would incur losses by commiting to the specific relationship, since the debtor may go bankrupt leaving its production unfinished and the other firms' commitment may become worthless. If this suspicion prevails in the economy, firms lose confidence in committing to a specific relationship with strangers. Thus the chains of production and the division of labor between firms shrink, and firms undertake fewer productive activities so that they can be conducted in narrow circles. As a result, output and productivity fall. The decline in observed productivity leads to the decline in asset prices and increases pessimism.

1.1 Literature

Recent studies in macroeconomics emphasize the importance of the credit constraints caused by information asymmetry and the principal-agent problems. Kiyotaki and Moore (1997) examine the case where the principal-agent problem limits the amount borrowed by a firm. The upper limit is determined by the value of collateral, e.g., land. This limitation amplifies the productivity shock and generates cyclical movements of output. Their result is that this *ex ante* constraint on the availability of money causes inefficiency. The "financial accelerator" models treat this problem (See, for example, Bernanke and Gertler[1989]; Bernanke, Gertler and Gilchrist[1996]).

The consideration about the principal-agent problem also produces the social norm which works as the *ex post* penalty for the moral hazard. The norm is to prioritize the existing debt over the new debt. To prevent the debtors from shirking, there is the practice that a failed debtor cannot receive new money unless he/she proves that the existing debt can be repaid. Thus, once the debtor fails, he/she is often forced to stop the business even when its going-concern value is positive. While this penalty to the defaulter guarantees the debtor's diligence *ex ante*, it causes *ex post* inefficiency because a valuable business has to be stopped in some cases. This inefficiency is called the "debt overhang problem"(Hart[1995]). If a failure of a debtor is idiosyncratic, the debt overhang problem does not make a macroeconomic problem. However, a financial shock such as the asset market collapse may distress many debtors simultaneously. Lamont (1995) shows that the simultaneous "debt overhang problems" may generate a stagnant equilibrium by changing macroeconomic expectations.

Note that the financial accelerator models and the Lamont model illustrate ordinary business cycles rather than a persistent stagnation. This is obvious for the financial accelerator models, since the credit constraint does not change the equilibrium but just amplifies the deviations from the optimal equilibrium. We can also reason that the inefficiency of the Lamont model, which is a two-period model, cannot continue for a long period. That is because the defaulters eventually go bankrupt through the inefficiency due to "debt overhang" such as the halt of operations or the deterrence of new investments. This inefficiency is the *"punishment"* to debtors for their default. The defaulters eventually exit, and then the inefficiency no longer persists. The entry of new entrepreneurs leads to economic recovery. Thus, the recession due to debt overhang in the Lamont model is not persistent.

In the analysis of a persistent stagnation or even standard business cycles, we need to see another macroeconomic inefficiency of corporate-debt overhang, i.e., the inefficiency due to *Debt Forbearance* or *"unfinishedness"* of the penalty, which is treated in the model of this paper.

1.2 Macroeconomic Inefficiency due to Debt Forbearance

In this section, we will briefly outline the macroeconomic inefficiency due to the forbearance of restructuring corporate-debt overhang.

The mechanism of the decline of productivity in our model is similar to the "disorganization" in the former Soviet Union modeled by Blanchard and Kremer (1997). In their model, inefficiency due to bargaining problems arises as the coercive power of the central planner is weakened. This is because, in the former Soviet Union, only the coercive power has guaranteed firms' commitments to specific relationships. On the other hand, in our model, corporate control is transferred from the shareholder to the creditor when default occurs. This shift of the right of control makes the debtor's commitment untrustworthy for its trading partners.

Suppose that a product is made by means of either N-Technology or S-Technology. N-Technology is a Leontief-type technology in which two firms produce different intermediate goods (m_i and m_j) from the labor input and assemble them into the final good (y). The production function of N-Technology is $V(m_i, m_j)$ where

$$y = V(m_i, m_j) = 2 \times \min\{m_i, m_j\},$$

and

$$m_i = \Lambda l_i \ \text{ and } m_j = \Lambda l_j,$$

where Λ ($\Lambda > 1$) is a parameter, and l_i (l_j) is the labor input of firm i (firm j). S-Technology is the production by a single firm with the production function:

$$y_i = F(l_i) = l_i.$$

We assume that there is the following "specificity" in the relationship between firm i and firm j: the intermediate goods m_i (m_j) creates a joint surplus only with m_j (m_i), and the intermediate goods have no alternative use. We also assume that there is the following "incompleteness" of contract: firm i and firm j can decide how to divide y only after they produce the intermediate goods. Thus we assume that they use Nash bargaining to divide the output y. Another point of this "incompleteness" of contract is that the two firms cannot predetermine the penalty in the contract for breaking the commitment to provide the intermediate goods.

Therefore, there are three possible outcomes for one firm. Assuming that each firm is endowed with one unit of labor, firm i obtains one if it chooses S-Technology. If firm i chooses N-Technology, it obtains Λ when both firm i and firm j produce the intermediate goods m_i and m_j, and firm i obtains 0 when it produces m_i while firm j does not supply m_j.

Suppose that the manager of a firm has no other choice than to continue production according to the technology chosen. He stops production only when he resigns or is dismissed. We assume that the manager incurs a huge private cost through dismissal (or resignation). Therefore, the manager will never stop production unless the owner of the firm dismisses him.

The owner of a firm can dismiss the manager and stop production at any time. When the firm stops production, it still produces liquidation value. Under normal circumstances, the creditor's claim is bigger than the liquidation value and the owner (= shareholder) has zero profit by dismissing the manager. This payoff guarantees that the owner will not dismiss the manager during N-production. Therefore, a firm fulfills the commitment to produce the intermediate good, and a firm always obtains Λ if it chooses N-Technology. Therefore, in normal circumstances, all firms choose N-Technology and the economy enjoys high productivity.

Next, suppose that a large-scale financial shock brought about the default of many firms, and that the creditors obtain corporate control. Corporate control typically means the right to dismiss the manager and stop production. If the creditors decide not to dismiss the managers and let them continue to operate their firms, then the structure of the game changes. A creditor can dismiss the manager during the production process of N-Technology and can cancel the commitment to produce the intermediate good. The creditor obtains liquidation value if he/she dismisses the manager, while he/she obtains zero if he/she produces the intermediate goods and the other firm does not. Therefore, to dismiss the manager may become the best choice for the creditor after the firm enters into N-production, if the creditor believes that the other firm is highly likely to fail to supply its intermediate good.

In this pessimistic case, the expected profits for the creditor of a firm become smaller when the firm produces the intermediate goods than when the creditor secures the liquidation value by dismissing the manager. In this case, choosing N-Technology becomes less profitable for the creditor than choosing S-Technology. Therefore, if pessimism prevails, all firms choose S-Technology and the economy suffers from low productivity.

Once S-Technology is adopted, the subjective probability that the other firm fails to supply its intermediate goods cannot be corrected, and the pessimism is self-reinforced.

This pessimistic equilibrium illustrates the basic idea of this paper: the forbearance of debt restructuring may create persistent inefficiency by breaking down the coordination between highly specialized firms in a supply network. We may call this problem "Disorganization due to Debt Forbearance." On the other hand, if the defaulters are punished according to the financial contracts, the inefficiency of "debt overhang problem" in the Lamont model may lead the economy into a sharp recession, though it may not last for a long time.

In the following sections, we will examine a model in which macroeconomic inefficiency due to Debt Forbearance generates stagnation. In Section 2, we define the basic elements of the model and construct the optimal equilibrium. In Section 3, we introduce debt overhang in the model and explain how the forbearance of restructuring debt overhang creates multiple equilibria. In Section 4, the empirical evidence from the Japanese economy is examined. In Section 5, the policies for the pessimistic equilibrium are proposed. Section 6 provides concluding remarks.

2 Model

The model is a partial equilibrium model of shareholders, banks and firm-managers, which is a development of the model by Kobayashi [2000].

Time is discrete and extends from zero to infinity. In every period, firms obtain labor input from shareholders and creditors, and they produce consumer goods. The owner of a firm is the shareholder. A firm divides its output between the bank and the shareholder at the end of every period. Although the manager produces the consumer goods as an agent of the shareholder and the creditor, the information asymmetry produces an incentive for the manager to shirk. For simplicity, we assume that the manager obtains utility directly from operating his firm, not from pecuniary income. To guarantee the manager's efforts, the financial contract determines that corporate control is transferred to the bank if production fails, while the bank is assumed to dismiss the unsuccessful manager at the end of the period.

2.1 Production Technology

There are E firm-managers in this economy, each of which operates one firm. We assume that E is very large number. These managers obtain labor input l_t from shareholders and creditors, and choose the production technology. The labor input l_t in the current period is transformed into output of consumer goods y_t at the end of the period. We assume that there are also E people who provide labor input to banks as depositors or to firms as shareholders. Each person is endowed with one unit of labor at the beginning of every period. Thus, the total endowment of labor is E units per period.

For simplicity, we assume that there are only two technologies: S-Technology (production by a single firm) and N-Technology (network of production or cooperation between two firms). N-Technology is a simplification of a complex chain of production which links many firms. The choice of technology by a firm is observable and the manager of a firm cannot change the choice of the current period once made.

2.1.1 Single production

The production function of S-Technology is

$$y = A_S l, \tag{1}$$

where A_S is the productivity parameter. When a firm uses S-Technology, it can produce consumer goods by itself, while it needs to cooperate with another firm in order to use N-Technology.

2.1.2 Production by Network of firms

Firms form pairs by random matching when they use N-Technology. Suppose that firm i and firm j form a pair. A firm transforms its labor to intermediate goods. The two firms combine their intermediate goods to produce consumer goods, the amount of which is larger than the sum of their outputs in S-Technology.

The production process of N-Technology is as follows. First, firm i transforms its labor (l_i) to m_i units of intermediate goods which cannot be used in S-Technology, where

$$m_i = A_N l_i \ (A_N > A_S).$$

Firm i and firm j can produce the consumer goods y by Leontief technology:

$$y = V(m_i, m_j) = 2 \times \min\{m_i, m_j\}.$$

The intermediate goods m_i (m_j) are useless without m_j (m_i) in production of y, and they have no alternative use without each other. This technological constraint on the intermediate goods represents "specificity" in this simple economy. We assume the following "incompleteness of contracts:" firm i and firm j can negotiate to make a contract to divide y only after they produce the intermediate goods. If the negotiations break down, the intermediate goods they produced become worthless. Thus y is divided equally by Nash bargaining. The point of this "incompleteness" is that the two firms cannot predetermine the penalty for breaking the commitment to provide the intermediate goods.

For simplicity, we focus on the symmetric case where all firms employ the same amount of labor: l and produce the same amount of intermediate goods: m. In this case, firm i obtains y_i by Nash bargaining where

$$y_i = y_j = A_N l.$$

Since $A_N > A_S$, N-Technology is more productive than S-Technology.

2.1.3 Relevancy of the Incompleteness Assumption

The above assumption of incomplete contracts in N-production seems too strong for developed countries like the Japanese economy. But it is plausible for our aim of analyzing the "slowdown" of economic growth which we conjecture is caused by the slowdown of the extension of supply networks.

In the major market economies, efficient legal system and market structures exist, which enable firms in a supply network to credibly pre-commit themselves to relation-specific investments. Thus, the firms in the existing supply networks can easily maintain their "specific" relationships, while a firm may face a difficulty when having to determine whether or not to extend its supply network to a new firm.

It is because the firms in the existing network play a multi-period game in which the players can develop strategies to make their commitment credible, while the game between a firm in the network and a newcomer may be a "one-shot" game if the newcomer reserves the option to exit in case of a bad outcome. Although the firms in the existing networks also reserve the right to exit the game, they have credibly showed their intention to play the multi-period game by, for example, paying the initial sunk cost when they joined the network. On the other hand, the firms in the network cannot tell whether the newcomer wants to play the multi-period game or merely a one-shot game.

Coming back to the model of N-Technology, suppose that the newcomer (firm i) agrees to pay compensation to firm j if firm i does not supply the intermediate goods m_i. This contract is not enforceable, however, if there exists a significant information asymmetry. If firm i can waste its resources and declare its bankruptcy to be due to "bad luck" while the outsiders cannot verify the alleged "bad luck," the compensation cannot be implemented when the commitment is broken. Firm i can exit leaving firm j very little residual payment that is significantly smaller than the agreed compensation.[1] In this case, Nash bargaining after the production of intermediate goods is the only measure for the two firms to divide the output.

Therefore, our assumption of incomplete contracts is plausible for analyzing the process of new firms' joining the existing supply networks rather than for analyzing the dissolution of the existing networks in a developed economy.

2.1.4 Dismissal During the Production

A firm-manager continues production unless he is dismissed by the owner of the corporate control of the firm. Once the owner dismisses the manager during production, the owner can continue production by him/herself using an inferior technology, and can produce a small amount of consumer goods at the end of the period.

If the manager is dismissed during S-production, the owner can produce $A_L l$ units of consumer goods using the remaining labor l, where

$$A_L < (1-p)A_S.$$

The paremeter p is the subjective probability that is defined in Section 2.2. This inferior production by the firm-owner in our model formalizes liquidation of the firm in reality.

We also assume the following for the productivity parameters:

$$A_N < A_S + \frac{1}{2}A_L. \tag{2}$$

Suppose that the manager of firm i is dismissed during N-production by the pair of firm i and firm j. Then the owner of firm i produces $A_L l_i$ units of consumer goods using the remaining labor l_i, while firm j knows of the bankruptcy of firm i only after it has produced the intermediate goods m_j. Since $m_i = 0$ and m_j is useless without m_i, firm j cannot produce any consumer goods.

This result tells us that the specificity of N-production makes the dismissal of a manager more costly for his trading partner rather than for the owner who dismissed the manager.

[1]We assumed the limited liability for the shareholder and the manager of firm i that can be found in most countries' commercial codes.

2.2 The Agency Structure

In the optimal equilibrium (See Section 2.4), the optimal contract determines that corporate control of the firm is transferred from the shareholder to the creditor when the firm defaults on its debt. The creditor is assumed to dismiss the manager right after the default.

In order to obtain this realistic form of financial contract, we need to set up an agency structure which explains why default occurs, and why it is optimal to transfer corporate control when default occurs.

We introduce a very simple structure of an agency problem. We assume that there is an idiosyncratic risk that the consumer goods is lost by an "accident" at the very final stage of its production. The probability of an accident becomes small if the manager exerts "effort" during the production, and it becomes large otherwise. We assume that the effort is not observable for shareholders or creditors.

Assumption 1 *An accident occurs with probability* p *if the manager exerts effort and with probability* P *if the manager does not exert effort, where* $0 < p < P \ll 1$*. The effort of a manager is not observable for the shareholder or the creditor. The output of consumer goods becomes zero when an accident occurs. The manager obtains disutility from exerting effort.*

Investors (a shareholder and a creditor) and a firm-manager make the contract contingent on default rather than on an accident itself because the default is a simple device to detect the occurrence of an accident whose nature may be difficult to describe beforehand. See Assumption 2 for the definition of "default."

Next, we assume that the manager receives private utility from operating his/her firm and does not obtain any utility from pecuniary income. Therefore, the manager bears the private cost of dismissal. Suppose that the private cost of dismissal is overwhelming for the manager compared to the cost of effort. In this case, the investors cannot design the incentive scheme by changing the manager's salary. The only way to penalize the manager who does not exert effort is to dismiss all managers who run into accidents.

Therefore, to dismiss the manager when a default occurs is the optimal measure for investors, since it is the only way to guarantee the manager's exertion.

2.3 The Course of Events

The summary of the course of events in one period is as follows (See Figure 2). At the beginning of the period, a financial contract is made between the shareholder, the creditor (bank) and the manager. The investors provide the firm with the labor input. Then the manager chooses technology S or N. If the manager chooses S-Technology, the firm just produces the consumer goods A_S. If the manager chooses N-Technology, the firm forms a pair with another firm. Before the firms produce the intermediate goods, the owners of the two firms have the chance to choose simultaneously whether to dismiss the manager or not. If both firms produce the intermediate goods, then Nash bargaining takes place and determines division of the output between the two firms. Then, the consumer goods are produced and divided between the firms. At the end of the period, the shareholder and the creditor obtain the returns according to the financial contract, and the manager is dismissed if he/she defaults on the obligation.

Figure 2: Timetable for a Firm

2.4 Optimal Equilibrium

For simplicity, we focus on the symmetric case where each firm uses one unit of labor input. We assume that the owners of all firms are shareholders at the beginning of the initial period.

2.4.1 The Optimal Capital Structure

The shareholders determine the ratio of debt/equity in order to maximize the rate of returns on their investment.[2] The debt contract in this economy has the following form.

Assumption 2 *If creditor lends d units of labor at the beginning of period t, the debtor must repay $\frac{R_t}{1-p}d$ units of consumer goods at the end of period t, where R_t is the market rate of returns at period t. If the repayment is less than $\frac{R_t}{1-p}d$, the debtor is regarded to be a "defaulter." Once default occurs, the right to dismiss the manager of the debtor firm is transferred from the shareholder to the creditor. Then the creditor obtains the discretionary right to decide whether and when he dismisses the manager.*

The optimal ratio of debt/equity must satisfy the following two conditions. The first condition is that the optimal ratio guarantees the manager's exertion. For this purpose, it is sufficient that the amount of debt is so large that "default" occurs once an accident happens. In this simple model, the firm cannot pay anything to the bank when an accident happens, because all the output is lost. Therefore, this condition is satisfied if and only if the amount of debt is positive.

[2] Alternatively, we can assume that the size of the investment from the shareholder is predetermined. If so, what the shareholder is to determine is the size of bank debt. Once the size of bank debt is determined, the amount of labor input that the firm can buy is determined. However, we can normalize the labor input of a firm to one unit without losing the generality, because the production functions are linear on labor. Therefore, we can assume that the shareholder determines the ratio of debt/equity instead of the size of the debt.

The second condition for the optimal ratio of debt/equity is that it guarantees that N-Technology is chosen and N-production is completed. Suppose that firm i and firm j enter N-production. Then the owners (= the shareholders) of these firms play a simultaneous game with two strategies: "C" and "L." Strategy "C" is to let the manager complete production of the intermediate goods. Strategy "L" is to dismiss the manager before produces the intermediate goods and to produce A_L units of the consumer goods by using inferior technology.

The argument of Section 2.1.4 implies the following result. If both owners choose "C," then each firm obtains A_N units of the consumer goods. If both owners choose "L," then each firm produces A_L. If the owner of firm i chooses "C" while the owner of firm j chooses "L," then firm i produces 0 and firm j produces A_L.

The optimal ratio of debt/equity must guarantee that the owners of both firms choose "C." This is the second condition. This condition is satisfied if the payoff of the owner (= the shareholder) is 0 when he/she chooses "L." The payoff is zero when we set the debt level so that the repayment to the bank can be larger than or equal to A_L. In this case, the best choice for the shareholder of firm i is to choose "C" regardless of the choice of the shareholder of firm j. Thus the second condition is satisfied.

Thus, we have the following result: The optimal ratio of debt/equity which satisfies the two conditions above is denoted by $d/(1-d)$ where the shareholder invests $1-d$ units of labor and the bank lends d units to the firm, and

$$d \geq \frac{(1-p)A_L}{R_t}.$$

Since the repayment to the bank is $\frac{R_t}{1-p}d$, the shareholder obtains 0 if he chooses "L" during N-production regardless of the other firm's action. Note also that $R_t = (1-p)A_N$ in the optimal equilibrium where N-Technology is dominant. This capital structure ensures that all firms produce the intermediate goods in N-production and each of them obtains A_N units of the consumer goods unless it has an accident at the final stage of production.

Therefore, the optimal contract between the shareholder, the bank, and the manager at the beginning of period t is the following. *"The shareholder invests* $(1-d)$ *units of labor input and the bank lends* d *units of labor to the manager. The manager must choose N-Technology. If the repayment to the bank is less than* $d\frac{R_t}{1-p}$ *units of the consumer goods, the right to dismiss the manager is transferred from the shareholder to the bank."*

This contract is socially optimal as well as privately optimal for the shareholder. In the negotiation of the contract at the beginning of the period, the shareholder is the principal who designs the contract and offers it take-it-or-leave-it to the agent (manager). The bank merely lends as much money as the shareholder wants, taking the market rate of returns R_t as a given parameter, where $R_t = (1-p)A_N$. Since banks diversify the risk of accidents by diversifying their investments to many firms, it is optimal for banks to lend money mechanically rather than to behave strategically when contracting with the other parties.

2.4.2 Equilibrium Allocation

Define π as the subjective probability, for people in the economy, that the owner of a firm chooses "L". π is exogenously given for individual agents. We assume that the economy was initially in the following "unorganized" stage: all firms have no debt and only the shareholders provide the input, and $\pi = 1$. In this initial stage each firm chooses S-Technology since the other firms are sure to choose "L" if they enter N-production. We have the following result.

Theorem 1 *If the economy is in the initial stage described above, the shareholder of a firm will choose the optimal debt/equity ratio, regardless of the other firms' capital structure.*

See Appendix 1 for the proof.

Thus all firms attain the optimal capital structure. Then N-Technology becomes the optimal choice. In every period, the firm obtains one unit of labor from investors after the financial contract is made. Then the firm chooses N-Technology and produces A_N units of consumer goods. Since the output is lost by an accident at the final stage of production with probability p, the corporate control of the firm is transferred to the creditor (= the bank) if the firm has an accident. If the bank obtains corporate control, it will dismiss the manager and sell off the firm immediately. [3]

At the beginning of period $t+1$, new managers are assigned for the firms which had accidents in period t. Then the banks, the shareholders and the managers make the optimal contract for period $t+1$, and N-production follows.

The aggregate output of the consumer goods is $(1-p)A_N E$. The economy enjoys high productivity in this optimal equilibrium, because the division of labor between firms works smoothly.

3 Equilibrium with Debt Overhang

3.1 Introduction of Debt Overhang

Suppose that the economy was in the optimal equilibrium without debt overhang initially. In period t_0, the economy receives an exogenous financial

[3] The bank dismisses the manager after production of period t is over. Since the firm does not have any disposable assets in this simple model, the bank does not obtain anything by dismissing the manager and selling off the firm at this point of time. Thus default works only as a penalty to the manager.

shock which hits all firms *after* optimal financial contracts are made and firms begin production. Suppose that the firms' repayment to the banks is reduced to $d\frac{R_t}{(1-p)} - D$ by this shock, where $D > 0$. Of course, the shareholders obtain zero returns. The collapse of the real estate market may be an example of this shock.

In this case, corporate control of the firm is transferred to the creditor according to the optimal contract. Assume that this financial shock is observable for all agents in this economy. Since banks know that the managers are not responsible for their default, they have no reason to dismiss the managers. The dismissal is a device to prevent managers' moral hazard by penalizing defaulters regarding all of them as suspects of moral hazard, while, in this case, banks know that the macroeconomic shock caused default of their debtors. In addition, banks may believe that the adverse effect of the financial shock is temporary, so that the loss will be recovered sooner or later if they choose the forbearance.[4]

We simply assume that, instead of dismissing managers, banks let managers operate their firms and establish D as the managers' debt overhang that must be repaid as soon as possible or when a positive financial shock occurs.

Assumption 3 *The creditor of debt overhang D has corporate control of the firm, and reserves the right to dismiss the manager.*

Since creditors withhold from exerting their rights voluntarily, they have the discretionary power to decide whether and when they dismiss the managers.

Note that D is a "nominal" figure in the asset side of the balance sheet of the creditor and in the liability side of that of the firm, while D is a dead weight loss in "real" terms. Since the debt overhang is created by an unexpected financial shock, we can plausibly assume that the market of bank loans where the debt overhang (distressed loans) is traded by banks does not exist. Note that trade of debt overhang is accompanied by transfer of corporate control.

Assumption 4 *The market of debt overhang accompanied by corporate control does not exist.*

Thus, the debt overhang with nominal value of D does not have the market price and its real value is zero, at least for economic agents other than the creditor and the debtor of the debt overhang.

In summary, banks obtain corporate control of firms according to the contract. But they decide not to exert their right. Managers are given temporary and discretionary respite from dismissal by banks.

[4] In the reality of the Japanese economy in the 1990s, the Ministry of Finance published new principles of financial supervision in 1991 which implicitly admitted that banks need not recognize the impairment of bank loans immediately, otherwise banks themselves would have gone bankrupt, because the decline of the asset prices was too large.

Next, firms need new money (one unit of labor) to operate every period from period t_0+1 on. The creditor of debt overhang may or may not provide new money for the debtor firm. For the simplicity of the following argument, we assume that the creditor finances the existing debtor.[5]

Assumption 5 *The creditor of debt overhang provides the necessary amount of new money for the debtor every period. His claims (D and new money) on the firm's output have priority over other investors' claims, if any.*

Even if other investors provide part of the necessary money for the firm, the arguments in the following sections hold, as long as the creditor of debt overhang has priority over the other investors, and we can conclude that there is a higher probability that the economy is trapped in a pessimistic equilibrium.

3.2 Cost of Debt Restructuring

The characteristic of the creditor of debt overhang is that he has the discretionary right to dismiss the manager *and* the senior claim on the firm's output. We define *debt restructuring* as any change in this condition. Simple debt forgiveness, in which the creditor gives some junior claimants (e.g., the existing shareholder) the right to dismiss the manager and gives up part of his senior claim is one example of debt restructuring. The debt-to-equity swap, in which the creditor gives up the priority of his claim and becomes the new shareholder of the firm, is another example. In any case, D is to be written off from the asset side of the creditor's balance sheet and the liability side of the debtor's balance sheet by debt restructuring.

What happens if the creditor does not do debt restructuring? The creditor of debt overhang D has the right to demand the repayment which has the present value of D. Meanwhile, the creditor needs to collect new money from depositors in order to provide it to the debtor. If so, we assume the following.

Assumption 6 *Banks are in a competition where they are forced to pay back all the returns from firms to the depositors who provided new money every period. Thus banks cannot reduce the size of bad loan D on their balance sheet.*

Recall that endowment of labor to this economy is the same amount E every period. Thus E units of labor input are provided to firms as "new money" directly from people or through banks, and all the output of firms are paid back to people (depositors) at the end of every period. Thus banks have no excess profit to make up the bad loan D.

[5]In the case where the creditor does not provide new money for the debtor and the debtor needs to find a new investor, the economy is more likely to go into a recession, since firms suffer from the debt overhang problem of the Lamont model.

Therefore, under this assumption, debt overhang D has no real value for the creditor. Thus it seems costless to dispose of the bad loan from the creditor's balance sheet. In reality, however, disposal of bad loan necessitates the "real" cost of coordination among stakeholders or within the bank. For example, the bank manager who is to blame for making bad loans usually opposes writing off the bad loans. Therefore, we assume the following.

Assumption 7 *Debt restructuring of one debtor involves the coordination cost Z for the creditor of debt overhang where*

$$0 < Z < (P - p)A_S.$$

Z can be a very small number since $p < P \ll 1$. This constraint on the cost of debt restructuring guarantees that banks do debt restructuring if their debtors default due to accidents in the optimal equilibrium.

3.3 Phase Transition of Equilibrium Strategy

The transfer of the corporate control to the creditor due to the financial shock gives the creditor a chance to choose "C" or "L" *after* the firm enters into N-production. If the creditor chooses action "L," he can seize labor (l) before it is transformed to the intermediate goods (m), and can produce $A_L l$ units of consumer goods.

Suppose firm i and firm j form a pair and enter into N-production. The creditors (bank i and bank j) simultaneously choose "C" or "L." If bank i chooses "C" while bank j chooses "L," firm i cannot produce the consumer goods. Therefore, this game between bank i and bank j is of the "hawk and dove" type.[6] The payoff in the symmetric case where $l = 1$ is as follows.[7] Bank i's expected gain of consumer goods is $(1-p)A_N$ if both banks choose "C;" bank i obtains A_L if it chooses "L;" and bank i obtains 0 if bank i chooses "C" while bank j chooses "L". Thus, the optimal strategy for bank i is "C" if bank j chooses "C", and "L" if bank j chooses "L."

Define π as the subjective probability of people in the economy that a bank chooses "L" during N-production. Thus, π is bank i's subjective probability that bank j chooses "L." Therefore, the expected payoff of bank i is $(1-\pi)(1-p)A_N$ if it chooses "C," and A_L if it chooses "L". The expected payoff of bank i is $(1-p)A_S$ if it chooses S-Technology. Therefore, we have multiple equilibria in this economy. If people have the pessimistic view that $\pi > \pi_0 \equiv 1 - \frac{A_S}{A_N}$, all banks and their debtors will choose S-Technology. In this case, the pessimism persists since π has no chance to be corrected by

[6]We assume that the number of banks in this economy is a finite number M, while the number of firms is E, where $M \ll E$. In this case, bank i happens to be bank j with probability $\frac{1}{M}$. We simply neglect this case assuming that M is very large.

[7]Note that all output is the gain for banks because we have Assumption 5 and the managers do not demand the consumer goods.

banks' actions. If people have the optimistic view that $\pi < \pi_0$, all banks and their debtors choose N-Technology and strategy "C", and π converges to 0. We have the following result.

Theorem 2 *Suppose that the corporate control of all firms are transferred to banks due to a macroeconomic financial shock. Once the pessimism prevails ($\pi > \pi_0$), all banks and firms choose S-Technology. The aggregate output becomes $(1 - p)A_S E$.*

At the beginning of every period, banks provide new money to the debtors. Debtors produce the consumer goods by S-Technology and pay all the output to banks as the returns for new money. Debt overhang D remains the same and banks never choose debt restructuring (See the next section for an explanation of the reason). Therefore, in this pessimistic equilibrium, the networks of specialized firms are disorganized, and macroeconomic productivity and output decline. [8]

3.4 Persistence of the Pessimistic Equilibrium

Once the economy is trapped in the pessimistic equilibrium, banks have the incentive to keep corporate control of debtors, because the creditors cannot benefit from losing corporate control if the other banks keep corporate control of their debtors.

Under the pessimistic equilibrium, suppose a bank restructures the debt overhang of its debtor firm and the firm recovers the optimal capital structure. The debt restructuring may or may not entail dismissal of the manager, selling off the firm, or simple debt forgiveness. The point of debt restructuring is that the owner of corporate control becomes a junior claimant (shareholder). The recovery of optimal capital structure guarantees that the new owner (shareholder) of the firm always chooses "C," once the firm enters into N-production. However, since the recovered firm, if it chooses N-Technology, needs to form a pair with another firm carrying debt overhang, the asymmetry in the capital structure and the allocation of corporate control between the two firms implies that Nash bargaining does not generate equal partition. If the result of Nash bargaining is expected to be very unprofitable, the other firms do not agree to form a pair with the recovered firm even though the recovered firm will be sure to provide the intermediate goods. In this case, the recovered firm is forced to choose S-Technology. Therefore, if

[8] In this pessimistic equilibrium, banks dismiss the managers who default again, in order to prevent managers from shirking. Thus, if a firm has an accident, the manager of the firm is dismissed and the creditor assigns a new manager. However, we simply assume that the creditor still hold the corporate control over the new manager and the senior claim on the firm's profit after the dismissal. This assumption enables us to neglect the entry and exit of firms and guarantees that the pessimistic equilibrium is stable against idiosyncratic shocks of accidents.

the recovery of the optimal financial structure by debt restructuring makes even a slight real loss, no banks chooses the restructuring. All banks choose to continue Debt Forbearance.

We will formally state the above argument. Suppose that the creditor (owner) of a firm restructures the debt overhang and the firm recovers the optimal capital structure. Then the corporate control of the firm is transferred to a junior claimant (shareholder). The dominant strategy for the new shareholder of the recovered firm is "C." Thus the recovered firm will be certain to produce the intermediate goods once it enters into N-production. Therefore, any firm could form a pair with the recovered firm and complete N-production if Nash bargaining divides the final output equally between the two firms. However, this may not be the case.

Consider the bargaining between the recovered firm and its partner carrying debt overhang. The bargaining takes place *after* both firms produce the intermediate goods. If they reach agreement in the bargaining, they produce $2A_N$ units of the consumer goods, while they produce nothing if they break up. The profit of the owner (shareholder) of the recovered firm is $y - X$, and the profit of the owner (creditor) of the other firm is $2A_N - y$, where y is the share of the recovered firm and X is the repayment to the creditor of the recovered firm. Since the capital structure of the recovered firm must satisfy the condition that the owner of the firm never chooses "L", $X \geq A_L$ must hold. We assume that shareholders and banks are both profit maximizers.[9] Therefore, the solution of Nash bargaining y^* is determined by

$$y^* = \arg\max_y (y - X)(2A_N - y).$$

Thus, $y^* = A_N + \frac{1}{2}X$. Therefore, the share of the firm carrying debt overhang is $A_N - \frac{1}{2}X$. If $A_N - \frac{1}{2}X < A_S$, no firms carrying the debt overhang will enter into N-production with the recovered firm, because they anticipate an unfavorable bargaining result.[10] In this case, the recovered firm is forced to choose S-Technology. Therefore, the investors of the recovered firm cannot obtain larger returns compared to those of the other firms.

Anticipating this result, since the recovery of the optimal capital structure (i.e., debt restructuring) is costly for the creditors, all banks continue to keep the corporate control of the debtor firms and to let them operate using S-Technology. Thus we have the following result.

Theorem 3 *The Condition (2) and Assumption 7 guarantee that all banks*

[9]If shareholders and banks have different "utility functions," the difference of the functional forms also makes the bargaining solution uneven.

[10]Note that we imposed the "incomplete contract" condition that the two firms in a pair cannot predetermine the division of the consumer goods *before* they produce the intermediate goods. Under this condition, the only choice for a firm anticipating the bargaining result is whether or not to form a pair with the recovered firm.

choose to keep corporate control of the firms in the pessimistic equilibrium. And they continue to choose S-Technology. Thus the pessimistic equilibrium becomes persistent.

Firms attain the optimal capital structure by the owners' choice in the initial period (See Theorem 1). Note that Theorem 1 is obtained by the assumption that setting a debt level is costless for the shareholder (firm-owner) in the initial stage. In the pessimistic equilibrium after the financial shock, the cost of the recovery of the optimal capital structure (Z) plays the key role to produce different result from that of Theorem 1. Incidentally, banks do debt restructuring if their debtor defaults in the optimal equilibrium, because the cost Z is overwhelmed by the gain of debt restructuring $(P - p)A_N$.

3.5 Fall of the Asset Prices

It is easy to incorporate a non-depletable capital input "land" in this model and make it the general equilibrium (See Kobayashi [2000] for a model of general equilibrium). Change the production function (1) of S-Technology to the following:

$$y = A_S k^{1-\alpha} l^{\alpha},$$

where k is the capital input. As for the production function of N-Technology, assume

$$y_i = A_N k_i^{1-\alpha} z_i^{\alpha},$$

where z_i is the "augmented labor" which is produced by a pair of firm i and firm j:

$$z_i + z_j = V(m_i, m_j) = 2 \times \min\{m_i, m_j\},$$

where m_i is the intermediate goods which is produced from labor: $m_i = l_i$. We also assume specificity between m_i and m_j and the incomplete contract. Thus, the division of z_i and z_j is determined by Nash bargaining.

We introduce the representative consumer who maximizes the utility $U = \sum_{t=0}^{\infty} \beta^t u(c_t)$, where the positive number β (< 1) is a discount factor, c_t is the consumption in period t, and $u(\cdot)$ is a concave and increasing function. In this general equilibrium setting, consumers are workers who provide labor input, and also depositors of banks and shareholders (landlords) who provide capital input (land). The arbitrage in the asset market equalizes the returns on bank deposit, on bank loan, and on investment in corporate stocks so that they can have the same rate of returns R_t, which is determined by $R_t = u'(c_t)/\{\beta u'(c_{t+1})\}$.

In this case, the land price is the discounted sum of the future returns from the land which is discounted by the market rate of interest $r_t \equiv R_t - 1$. Therefore, the land price is proportional to the productivity parameter of the chosen technology. In the optimal equilibrium where the output is constant, the land price is $Q_h = E[(\text{the dividend})]/(\text{the interest rate}) = \frac{(1-p)(1-\alpha)}{\beta^{-1}-1}A_N$.

In the pessimistic equilibrium, the land price falls since the productivity parameter changes from A_N to A_S. Therefore, disorganization due to pessimism causes the decline of asset prices through the fall of macroeconomic productivity.

4 Evidence in the Japanese Economy

Did disorganization occur in the Japanese economy in the 1990s? One supporting evidence of the shrinkage of economic transactions due to prevalent suspicion is the decrease of credit transactions in the Japanese economy. Figure 3 shows the total volume of the bills and checks clearings and the domestic fund transfer through the inter-bank computer network. This figure indicates the sharp contraction of business transactions. It may imply that supply networks and the division of labor between firms was damaged continuously throughout the 1990s.

Next, we obtained the empirical result showing the negative correlation between the output growth and the complexity of supply networks in the Japanese economy in the 1990s.

4.1 Complexity and Disorganization

In the theoretical model in the previous sections, we assumed that a network of firms consists of only two firms, for simplicity of exposition. In reality, the number of firms which a production network consists of must affect the magnitude of disorganization, as Blanchard and Kremer argue.

Let us generalize our previous model as an example to show a correlation between the complexity of a supply network and the disorganization. Suppose that n firms, instead of two firms, need to form a group for N-production, and that the consumer goods y is produced from the intermediate goods m_i $(i = 1, 2, \ldots, n)$ by the following Leontief technology,

$$y = V(m_1, m_2, \ldots, m_n) = n \times \min\{m_1, m_2, \ldots, m_n\}.$$

Assume that the other parts of the model are the same as the previous sections. Firms choose S-Technology or N-Technology. The financial shock transfers the corporate control of firms from shareholders to banks. Let π denote the subjective probability with which people believe that a bank choose "L" during N-production. In this case, the expected profit of a firm is $(1-p)(1-\pi)^{n-1}A_N$ if it chooses N-Technology and completes the production of intermediate goods.

Therefore, if $\pi \leq 1 - \sqrt[n-1]{A_S/A_N}$, then all firms choose N-Technology and all banks choose "C". Thus π converges to 0.

If $\pi > 1 - \sqrt[n-1]{A_S/A_N}$, then all firms choose S-Technology. Since $1 - \sqrt[n-1]{A_S/A_N}$ is the decreasing function of n, the slighter pessimism can decrease the output of an industry where the number of firms in a supply network n is larger. Thus, given the value of π, the output of the industry decreases more, if the number of firms n increases more. We also have the following generalization of Theorem 2.

Theorem 4 *If $A_N < A_S + \frac{n-1}{n} A_L$, then all banks choose to keep the corporate control of debtor firms in the pessimistic equilibrium. And they continue to choose S-Technology. Thus the pessimistic equilibrium becomes persistent.*

Proof is provided in Appendix 2.

This argument implies that the occurrence of disorganization causes a negative correlation between n and the output growth. In the following sections, we introduce "the index of complexity" which represents n, and examine the relation between the complexity and the output growth by OLS analysis using data of the Input-Output Tables.

4.2 Data

Most of the data are from the Input-Output Tables published every five years by the Management and Coordination Agency (MCA). The I-O Table divides all industries into about 90 sectors. We used the 1975-1980-1985-Connection Table (83 Sector Classification), the 1980-1985-1990-Connection Table (90 Sector Classification) and the 1985-1990-1995-Connection Table (93 Sector Classification). We used the data on economic activities in the years 1975, 1980, 1985, 1990 and 1995, which are available from the I-O Tables.

The dependent variables are the growth rates of the real output of each sector during five-year periods: 1975-1980, 1980-1985, 1985-1990, and 1990-1995.

We used the following "index of complexity" c_i for sector i, which represents the number of firms n in the production network of sector i:

$$c_i = 1 - \sum_j (a_{ij})^2,$$

where a_{ij} is the share of input from sector j in the total input to sector i from all sectors. Thus $\sum_j a_{ij} = 1$. This index was first used by Blanchard and Kremer [1997]. By construction, c_i is equal to zero if there is only one input, and c_i tends to one if the sector uses many inputs in equal proportions. Thus c_i represents the complexity of input structure of sector i. We have assumed that the complexity of input structure of the sector approximates to the complexity of the supply network for a firm in the sector. Therefore, we regard c_i as representing the complexity of a network of firms (n) in sector i.[11] Table 1 shows the resulting complexity indices for the different sectors.

Table 1: Complexity Indices of Sectors

Note that the complexity may be a technological constraint on the sector rather than a charasteristic variable of firm behavior, because the input structure is determined by the production technology of the goods rather than by the firms' behavior alone. We assume that the high "complexity" indicates the technological character of the goods that necessitates a highly complex supply network. To see whether the complexity is a technological constraint or not, we calculated the order correlation between the complexity in 1985, 1990 and 1995. The result is shown in Table 2. The order correlation between the complexity of 1990 and 1995 is larger than that between 1985 and 1990, showing that the complexity in the 1990s did not change significantly despite the severe recession. This result implies that complexity is a technological constraint for the corresponding sector.

Table 2: Order correlation of complexities in 1985, 1990 and 1995.

There are seven independent variables of this analysis: the index of complexity, the durability, the debt burden, the growth rate of capital, the growth rate of labor, the growth rate of materials input and the constant term. See Appendix 3 for details of the data construction.

Durability is a dummy variable that is equal to one if the good is durable, zero otherwise. We used this variable since the production of durable goods is typically procyclical relative to the production of nondurables in the major developed countries (Blanchard and Kremer [1997]).

The debt burden is the ratio of the debt outstanding to the annual operating surplus. This ratio is assumed to measure the credit constraint which is expected to depress the firm's output. We conjecture that the coefficient of this ratio represents the negative effect of debt that is shown in the financial accelerator models and in the Lamont model.

4.3 Regression Result

The regression model takes the following form:

$$g_i = \beta_0 + \beta_1 c_i + \beta_2 \delta_i + \beta_3 db_i + \beta_4 gk_i + \beta_5 gl_i + \beta_6 gm_i + \epsilon_i,$$

where g_i is the growth rate of real output of sector i, c_i is the complexity at the beginning of the regression period, δ_i is the durability dummy and db_i

[11] We used the Herfindahl index of input shares to make c_i. However, the Herfindahl index may not be the best measure for the complexity of input structure. We can use the Gini index or the Theil index of input shares instead of the Herfindahl index. We also implemented the regression analysis by the Gini- and the Theil-type indices (Kobayashi and Inaba [2000]). The results are almost the same as that of the Herfindahl-type index reported in this paper. They are supporting evidence for the validity of our result.

is the corresponding debt burden at the beginning of the regression period. gk_i, gl_i and gm_i are the growth rates of capital input, of labor input and of materials input, respectively. We assumed that the change of output can be divided into the part due to the change of input and the other part due to the change of efficiency. We have conjectured that the complexity, the durability and the debt burden affect the efficiency.

Our main result is shown in Table 3.

Table 3: Regression Results

The regression result for the output growth of the period 1990-1995 contrasts significantly with that of the other periods. The coefficient of the complexity index is significantly negative at the 1 percent significance level in the period 1990-1995, while it cannot be significantly estimated in the 1970s nor in the 1980s. This result indicates the existence of disorganization in the 1990s, and that the disorganization occurred just after the asset-price bubble burst and also after the forbearance policy was chosen implicitly by banks and the supervisory authority in 1991. Thus the result is consistent with the prediction of our theory that Debt Forbearance causes the contraction of the economy through disorganization.

The coefficient of the debt burden is significantly positive in 1990-1995. This result is quite counter-intuitive, because conventional wisdom is that one of the main causes of the persistent stagnation in the 1990s was the credit crunch due to the bad loans problem. On the contrary, our result indicates that the credit crunch was not necessarily the primal cause of the Japanese stagnation.[12] Another possibility is that the debt burden works through changes in capital input. The "debt overhang problem" of an individual firm is that the debt burden reduces the investment of the firm. Thus, we can conjecture that the debt burden has a negative effect on the growth of capital in the corresponding industry. Table 4 shows the regression result of the capital growth (gk) by the debt burden (db). The correlation is significantly negative in the 1990s, indicating the plausibility of our conjecture.

Table 4: Regression of Capital Growth by Debt-Burden

However, considering the indirect method of data construction, we cannot clearly conclude whether there was a negative effect of credit constraint on the economic growth directly or through capital accumulation.

Therefore, our main result indicates that the core problem of the Japanese economy in the 1990s was in the demand side of money, i.e., the weakness

[12] We cannot conclude that the credit constraint was not important. The reason is that the values of the debt burden may not be completely accurate because the data construction is indirect (See Appendix 2). Thus the debt burden is just a rough estimate of the credit constraint on individual sectors.

of corporate activities due to disorganization, rather than in the supply side of money, i.e., the credit constraint.

The result for the durability dummy was consistent with the prediction that it is procyclical: The periods of 1975-1980 and 1985-1990 were almost the expansion periods; and the period of 1990-1995 was almost the contraction period, in all of which the durability was significant.

The regression result can be summarized as follows: *the complexity has had a negative effect on the output in the 1990s, at the beginning of which Debt Forbearance was widely adopted.* This result indicates that some "coordination failure" has occurred in many of the supply networks in the corporate sector of Japan. One possible cause of this macroeconomic failure is the Disorganization due to Debt Forbearance.

5 Policy Implication

Since the Disorganization due to Debt Forbearance is an "external effect" of creditors' decision that they forbear punishing the defaulters, market competition alone cannot recover social optimum unless people's expectations change simultaneously. Thus a public policy becomes necessary once the economy is trapped in the pessimistic equilibrium. There are three types of possible remedies.

The cause of the pessimistic equilibrium is that the banks obtain the right to dismiss the managers and withhold from exerting it. Thus the first remedy is to make all banks exert the right, by making banks have their debtors undergo the bankruptcy procedure. For banks, to let the debtors operate is the optimal choice once the economy is trapped in the pessimistic equilibrium. Therefore, the implementation of bankruptcy seems to necessitate a strong compulsion by the regulator. On the other hand, the increase of bankruptcies may cause a sharp recession by credit crunch. Thus the aggregate demand management by, for example, injection of public money into the capital account of banks' balance-sheets is necessary to avoid a deflationary spiral.

The second remedy is to recover the optimal capital structure out of court, i.e., private debt restructuring. If the payoffs of all firm-owners (banks) change so that "C" is the dominant strategy in N-production, then the coordination failure will be solved and firms will adopt N-Technology. One way to reconstruct the optimal capital structure is to convert a portion of the debt overhang to equity (the debt-to-equity swap). However, as we examined in Section 3.4, debt restructuring is not the optimal strategy for a bank if the other banks keep the status quo. Thus the important point is that *the optimal capital structure must be recovered simultaneously by a substantial number of firms.* Therefore, the public coordination of private debt restructuring to synchronize with each other is necessary. However, it is a variation of publicly coordinated debt forgiveness, which may sow the seeds of moral hazard in the firms' management if people expect that debt forgiveness will be repeated in the future. Therefore, the policy-maker needs to design appropriate penalties for existing managers and shareholders in order to prevent the moral hazard problems in the future.

The third remedy is to establish a market of debts overhang and the accompanying corporate control of firms. The "hawk and dove"-type structure emerges from the fact that firms have different creditors (owners). Suppose that creditors can trade their claims and corporate control after a pair of N-Technology is formed. Then one creditor can obtain corporate control of both firms. In this case, the payoff of the creditor is maximized when the output of the pair is maximized. Thus social optimum is attained. The trade of claims on debt overhang will restore the macroeconomic confidence in business transactions.

Since the trade of debt overhang is beneficial for banks, it seems likely that they would trade their claims voluntarily. However, since the bank loans were not traditionally tradable, it would be very costly for private agents to facilitate the market for trading of bank loans. The market institutions may need to be designed appropriately by the public sector. For example, to provide fair accounting rules and an efficient bankruptcy procedure facilitates the active trade of bank loans. An example of a more aggressive policy is to make a semi-governmental financial institution issue the Collateralized-Loan-Obligation(CLO) securities[13] backed by private bank loans. The issuance of public CLOs may work as a catalyst to activate the trading of corporate debts, as the Mortgage-Backed-Securities of the Federal National Mortgate Association activated the securitization and trading of mortgage loans in the United States.

6 Concluding Remarks

The main result of this paper is that a financial shock on the balance sheet variables can affect the real output by raising suspicion about commitments to highly specific relations in complex chains of production. The inefficiency is caused by the prevalence of Debt Forbearance, which was not anticipated by the financial contracts that were optimal before the shock.

To deal with this inefficiency, the debt level in the private sector may be a possible target of macroeconomic policy. For example, a publicly coordinated debt restructuring program that forces banks to dispose of nonperforming loans simultaneously may be effective as a policy to bring back the stagnant economy to the sustainable growth path.

There may be another argument if we consider the case where an active market of distressed loans and an efficient bankruptcy procedure exist. In

[13] One kind of asset-backed securities that uses corporate loans as collateral.

this case, the pessimistic equilibrium becomes unstable since people can restore their confidence through disposal and trade of bad debts. Thus, we can conjecture that efficiency in institutions of financial markets and the bankruptcy procedure are the key factors to maintain and restore confidence. The reform of market institutions may therefore be important to remove future possibilities of persistent depression.

We do not insist that the aggregate demand management is ineffective at all. If a large shock occurres, the quick disposal of non-performing loans would cause a credit crunch, or it would create a debt overhang problem in the Lamont model, and would lead the economy to a sharp recession. Fiscal expansion may be necessary to stop this type of economic contraction. Our point is that the aggregate demand management alone cannot recover the growth path unless the macroeconomic confidence is restored through smooth debt restructuring in reliable market institutions.

Appendix 1

Proof of Theorem 1

We assume that the shareholder of a firm chooses the ratio of debt/equity in order to maximize the rate of returns (See also footnote 2). We call a firm a 0-firm if it has zero debt and a d-firm if it has d units of debt. In the initial stage, all firms are 0-firms. In a 0-firm, all the output is the shareholder's gain. There are two exogenous parameters given to the shareholder: R_t and π_t. R_t is the market rate of returns and π_t is the subjective probability that the other firm chooses "L" in N-production under the condition that the other firm is a 0-firm. Note that R_t is the ratio of total output of the consumer goods to the total labor input in this economy. Thus R_t satisfies

$$(1-p)A_S \leq R_t \leq (1-p)A_N.$$

Consider the case where $\pi_t > \pi_0 \equiv 1 - \frac{A_S}{A_N}$. In this case, the expected output of a firm becomes bigger when it chooses S-Technology rather than N-Technology. Therefore, in the initial stage where all firms are 0-firms, $R_t = (1-p)A_S$. We can show that setting the debt level at d is Pareto improving for the shareholder who maximizes the rate of returns (R_t^S).

Let x be the share of d-firms and $1-x$ be the share of 0-firms in this economy ($0 \leq x \leq 1$). In the initial stage, $x = 0$. At the beginning of a period, a firm encounters another firm by random matching and decides whether to form a pair with it for N-production. If a d-firm runs into another d-firm, they form a pair and complete N-production because they both have the optimal capital structure. If a d-firm and a 0-firm meet, the 0-firm decides not to form a pair and both firms choose S-Technology. See Section 3.4 for the reason why 0-firm denies. Therefore, the following equation holds:

$$R_t = x^2(1-p)A_N + (1-x^2)(1-p)A_S.$$

Given this, suppose that the shareholder of a firm sets the debt level at $d = \frac{(1-p)A_L}{R_t}$. Then the expected rate of returns R_t^S satisfies

$$R_t^S = \frac{x(1-p)(A_N - A_L) + (1-x)(1-p)(A_S - A_L)}{1-d}.$$

In the initial stage where $x = 0$, $R_t^S = R_t$. Thus a shareholder is indifferent as to whether to keep his firm as a 0-firm or to change it to a d-firm. We assume that some firms become d-firms. Then, x becomes larger than 0. In this case, it is easily shown that $R_t^S > R_t$ because $0 < x < 1$. Therefore, shareholders choose the optimal capital structure voluntarily as long as $x < 1$. Thus all firms attain the optimal capital structure eventually.[14]

Appendix 2

Proof of Theorem 4

In a production network of n firms, suppose that $n-1$ firms have already recovered the optimal capital structure and that only one firm still carries debt overhang. Once they enter the process of N-production, $n-1$ recovered firms are sure to produce the intermediate goods.

Suppose that a firm carrying debt overhang produces the intermediate goods in N-production. Then Nash bargaining takes place after it produces the intermediate goods. If we assume symmetry among the recovered firms, the solution of Nash bargaining is

$$(y^*, z^*) = \arg\max_{y,z}\ y \times (z - X)^{n-1}$$

subject to

$$y + (n-1)z = nA_N,$$

where y is the share of the firm carrying debt overhang, z is that of a recovered firm and X is the payment to the creditor of a recovered firm ($X \geq A_L$). Therefore, $y^* = A_N - \frac{n-1}{n}X$. If $y^* < A_S$, then the firm carrying debt overhang will never choose to form a production network with the recovered firms. This condition is always satisfied if $A_N < A_S + \frac{n-1}{n}A_L$. In this case, the recovered firms are forced to choose S-Technology. Anticipating this result, no banks choose restructuring of the debtor firms.

Appendix 3

Construction Method of Data Set

We calculated the index of complexity, the growth of labor input (the number of workers) and the growth of materials input directly from the input matrix of the I-O Table. We cannot obtain the data of capital stock and debt

[14] We assumed that shareholders have a discrete choice about the capital structure: 0-firm or d-firm. Even in the case where shareholders can choose the debt level continuously, we can still prove the theorem if we add several technical assumptions.

outstanding of each sector from the I-O Table. Therefore, we used the following indirect methods.

To calculate the growth rate of capital input, we used "the depreciation of fixed capital." Assuming that the depreciation rate is invariant over time and over plants and equipment in the same sector, we can regard the growth rate of the depreciation of fixed capital as a close approximate of the growth rate of capital, since

$$\frac{\Delta_i K_{i\ t+T} - \Delta_i K_{i\ t}}{\Delta_i K_{i\ t}} = \frac{K_{i\ t+T} - K_{i\ t}}{K_{i\ t}}$$

where Δ_i is the depreciation rate of sector i and $\Delta_i K_{i\ t}$ is the depreciation of fixed capital in period t. Therefore, we used the growth rate of the depreciation of fixed captal instead of that of capital input. We obtained the values of the depreciation of fixed capital at the current prices from the Input-Output Tables. We approximated their real values by multiplying them and the GDP deflator together.

To calculate the debt burden, we can utilize the input from the financial sector, because it is proportional to the debt outstanding of the corresponding sector. According to the MCA, the input from the financial sector to sector i (F_i) is calculated by

$$F_i = \frac{\text{Debt outstainding of sector } i}{\text{Total debt outstanding (all sectors)}} \times \{\text{Total output of financial sector}\}.$$

Since the total debt outstanding and the total output of the financial sector are common parameters for all sectors, we can use the ratio of F_i to the operating surplus instead of the ratio of debt outstanding to the operating surplus. Thus we used the former. To be more precise, F_i includes the input from the nonlife insurance that is not proportional to the debt outstanding. We simply neglect the effect of nonlife insurance because the total input to all industries from nonlife insurance is just 7 percent of that from the financial sector as a whole.

Finally, we set the value of the durability dummy at one for the following 24 industries: Timber and wooden products, Furniture and fixtures, Pig iron and crude steel, Steel products, Steel castings and forgings and other steel products, Non-ferrous metals, Non-ferrous metal products, Metal products for construction and architecture, Other metal products, General industrial machinery, Special industrial machinery, Other general machines, Machinery for office and service industry, Household electric appliance, Electronic equipment and communication equipment, Heavy electrical equipment, Other electrical machinery, Motor vehicles, Ships and repair of ships, Other transportation equipment and repair of transportation equipment, Precision instruments, Miscellaneous manufacturing products, Building construction, and Civil engineering.

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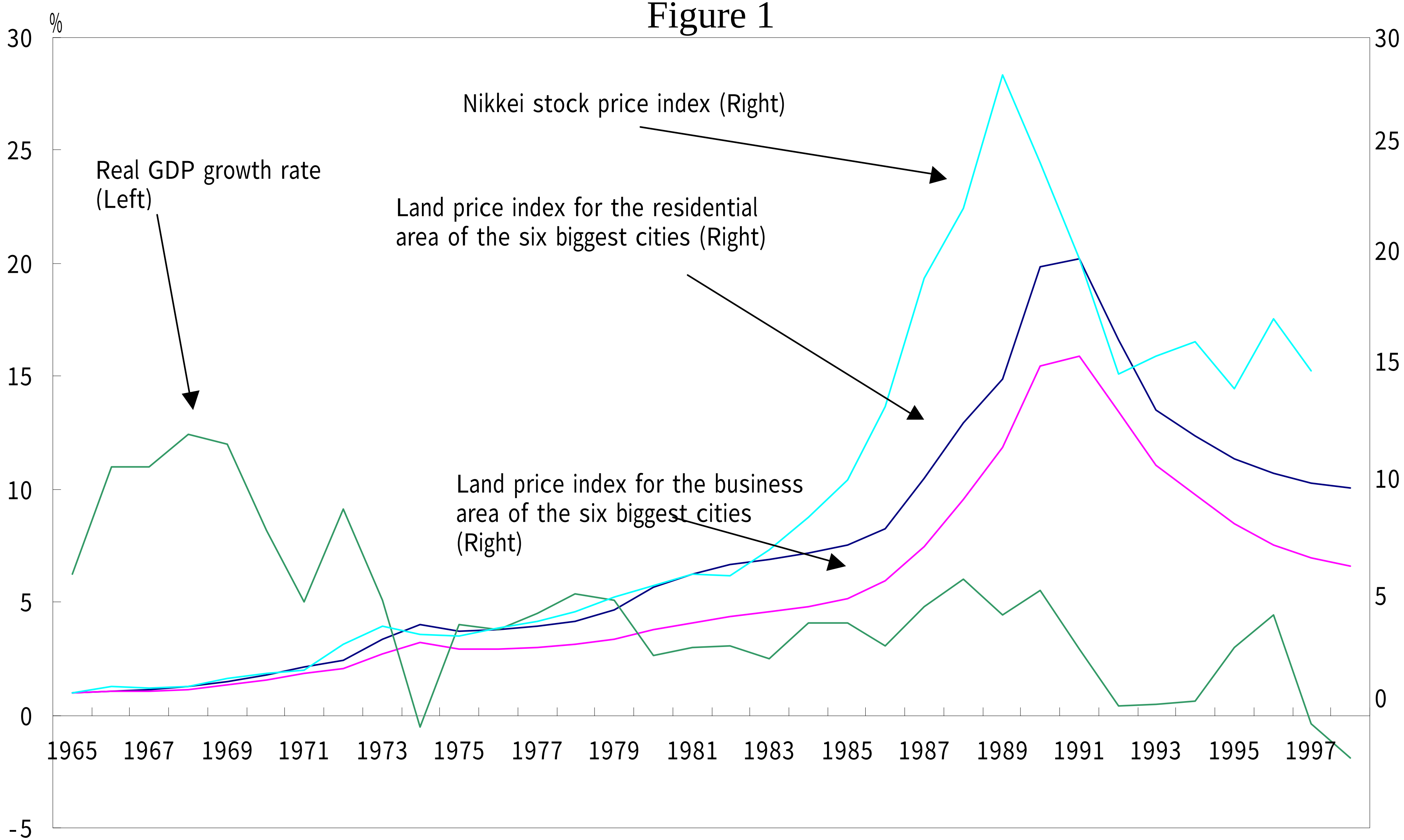
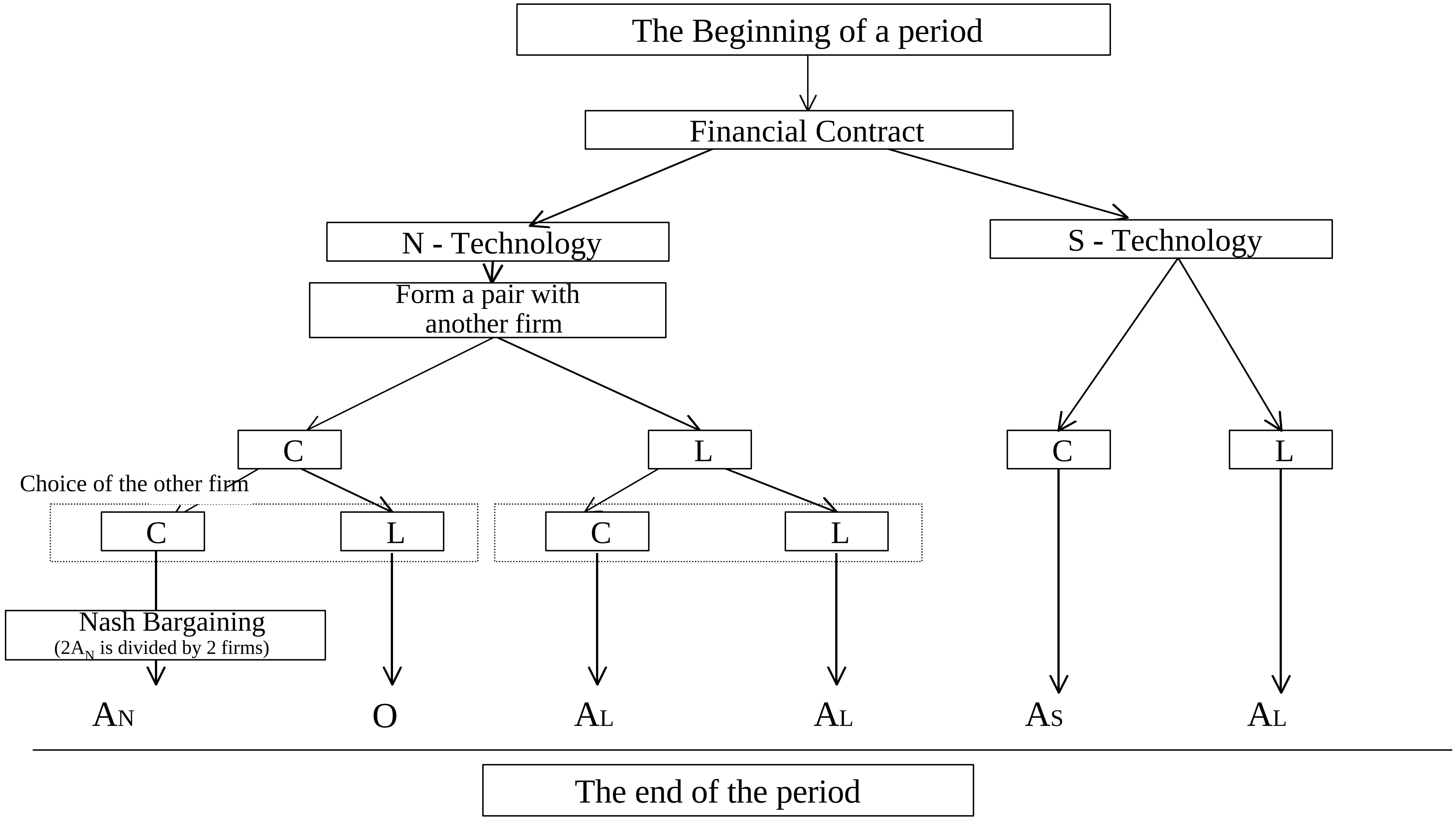
Figure 1



Source: Japan Real Estate Institute, Economic Plannnig Agency, Toyo-Keizai-Shinposha Publishing
Notes: a. The land price indices are as of March.
b. Each index is set at 1 in 1965.
c. The stock price is the annual average.



C = to let the manager complete the production of the intermediate goods.

L = to dismiss the manager before the intermediate goods are produced.

Figure 2 Time Table for a firm

Figure 3
Checks and Bills Clearing & Fund Transfer

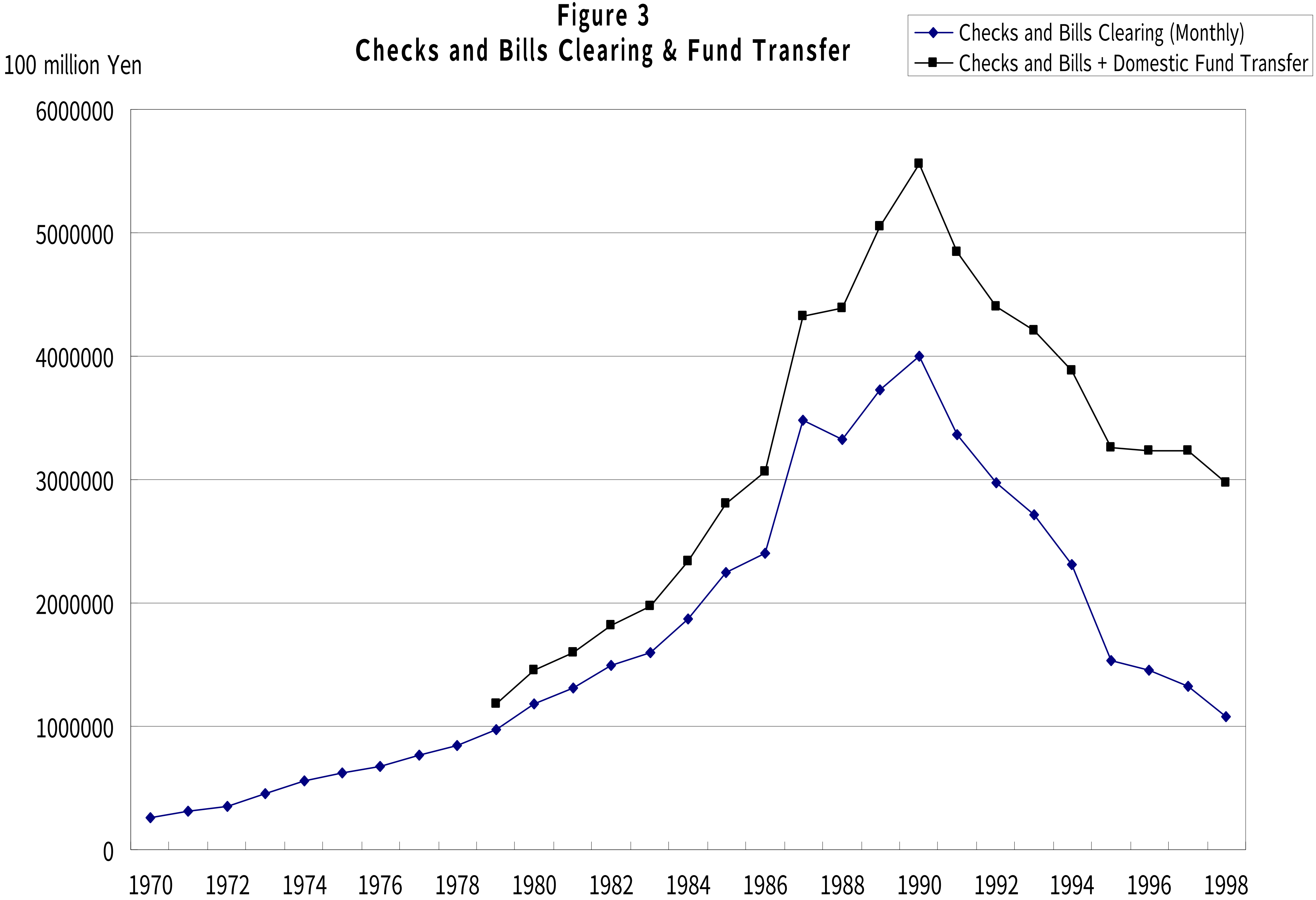


Table1: Complexity Indices of Sectors in 1990

Social security	0.949125287	Chemical fertilizer	0.88661561
Public administration	0.948284368	Other business services	0.886581032
Miscellaneous manufacturing products	0.948206619	General industrial machinery	0.885518242
Other personal services	0.9474493	Gas and heat supply	0.878346201
Amusement and recreational services	0.947061265	Real estate agencies and rental services	0.876675536
Pottery, china and earthenware	0.946387138	Other metal products	0.87512
Waste disposal services	0.945919155	Leather, fur skins and miscellaneous leather products	0.8737509
Other ceramic, stone and clay products	0.945282145	Road transport (except transport by private cars)	0.869094398
Glass and glass products	0.944312024	Machinery for office and service industry	0.867768386
Heavy electrical equipment	0.941390209	Finance and insurance	0.865554659
Education	0.938997281	Foods	0.860267595
Civil engineering	0.938627451	Storage facility services	0.854024788
Agricultural services	0.934489953	Eating and drinking places	0.848117044
Services relating to transport	0.933306158	Other transportation equipment and repair of transportation equipment	0.846426154
Building construction	0.929701945	Synthetic fibers	0.844215068
Repair of construction	0.927976461	Advertising, survey and information services	0.843075933
Ships and repair of ships	0.927846843	Publishing and printing	0.830274106
Research	0.926680115	Textile products	0.823025306
Hotel and other lodging places	0.925444077	Goods rental and leasing services	0.801756478
Communication	0.922393865	Office supplies	0.799593017
Final chemical products	0.921958594	Medical service and health	0.792705761
Other general machines	0.919129356	Livestock and sericulture	0.783046035
Activities not elsewhere classified	0.917892283	Electronic equipment and communication equipment	0.782893517
Coal	0.917717098	Pulp, paper, paperboard and processed paper	0.781140807
Commerce	0.917399745	Feeds and organic fertilizer	0.77249248
Crude petroleum and natural gas	0.916771799	Plastic products	0.770155426
Other public services	0.91671542	Broadcasting	0.763124833
Metallic ores	0.915784315	Non-ferrous metals	0.762041491
Drinks	0.913716468	Coal products	0.74959776
Fisheries	0.912759811	Timber and wooden products	0.747808207
Crop cultivation	0.911123649	Petrochemical basic products and intermediate chemical products	0.745730673
Furniture and fixtures	0.909437872	Water transport	0.741216809
Freight forwarding	0.908569879	Wearing apparel and other textile products	0.741079586
Medicaments	0.908289132	Air transport	0.739785633
Repair of motor vehicles and machines	0.904542291	Pig iron and crude steel	0.738694219
Precision instruments	0.904520584	Railway transport	0.715948961
Household electric appliance	0.901111271	Tobacco	0.714483378
Electricity	0.899157403	Steel castings and forgings and other steel products	0.707625691
Rubber products	0.897417436	Paper products	0.693907866
Water supply	0.893251631	Steel products	0.684464532
Cement and cement products	0.892007667	Motor vehicles	0.668048557
Inorganic basic chemical products	0.891299465	House rent	0.636684823
Special industrial machinery	0.88932864	Forestry	0.5822088
Other electrical machinery	0.888970498	Non-ferrous metals products	0.569753218
Non-metallic ores	0.888552629	Synthetic resins	0.526768219
Metal products for construction and architecture	0.888547533	Petroleum refinery products	0.295907821

Table 2: Order Correlation of Complexities			
Complexity	**1985**	**1990**	**1995**
1985	1		
1990	0.90293297	1	
1995	0.83413221	0.96566127	1

Table 3-1: 1975-1980 Regression Result

Dependent Variable: Growth Rate of Real Output (74 Samples)

Independent Variable	(1)	(2)	(3)	(4)
Constant Term	0.071	0.074	0.085	0.073
	(0.651)	(0.745)	(0.703)	(0.662)
Complexity	-0.068	-0.103	-0.084	-0.102
	(-0.511)	(-0.801)	(-0.583)	(-0.737)
Labor Growth	-0.141	-0.014	-0.141	-0.014
	(-0.835)	(-0.094)	(-0.827)	(-0.093)
Capital Growth	0.0686	0.110	0.071	0.110
	(0.634)	(1.107)	(0.641)	(1.088)
Materials Input Growth	0.915 ***	0.801 ***	0.913 ***	0.801 ***
	(5.049)	(4.753)	(4.986)	(4.707)
Durability	-	0.146 ***	-	0.146 ***
		(2.688)		(2.667)
Debt Burden	-	-	-0.002	0.00007
			(-0.441)	(0.018)
Adjusted R Squared	0.632	0.666	0.627	0.661

Table 3-2: 1980-1985 Regression Result (84 Samples

Independent Variable	(1)	(2)	(3)	(4)
Constant Term	-0.046	-0.050	-0.141	-0.162
	(-0.472)	(-0.480)	(-1.303)	(-1.356)
Complexity	0.117	0.103	0.215	0.217
	(0.939)	(0.788)	(1.660)	(1.574)
Labor Growth	0.018 **	0.020 ***	0.016 *	0.019 **
	(2.373)	(2.966)	(1.957)	(2.449)
Capital Growth	-0.003	-0.004	-0.003	-0.003
	(-0.858)	(-1.242)	(-0.643)	(-0.974)
Materials Input Growth	0.854 ***	0.850 ***	0.863 ***	0.859 ***
	(6.447)	(6.779)	(6.421)	(6.792)
Durability	-	0.053	-	0.061
		(1.241)		(1.404)
Debt Burden	-	-	0.020 *	0.023 **
			(1.908)	(2.054)
Adjusted R Squared	0.663	0.666	0.665	0.670

Table 3-3: 1985-1990 Regression Result (86 Samples

Independent Variable	(1)	(2)	(3)	(4)
Constant Term	0.065	0.059	0.054	0.048
	(0.511)	(0.453)	(0.427)	(0.372)
Complexity	-0.014	-0.023	-0.009	-0.018
	(-0.088)	(-0.147)	(-0.060)	(-0.120)
Labor Growth	0.245 **	0.232 **	0.252 ***	0.239 ***
	(2.591)	(2.533)	(2.708)	(2.645)
Capital Growth	0.101 *	0.094 *	1.01 *	0.093 *
	(1.711)	(1.671)	(1.752)	(1.717)
Materials Input Growth	0.506 ***	0.509 ***	0.507 ***	0.510 ***
	(5.794)	(5.638)	(5.831)	(5.670)
Durability	-	0.059 **	-	0.059 **
		(2.011)		(1.999)
Debt Burden	-	-	0.012	0.012
			(0.762)	(0.759)
Adjusted R Squared	0.703	0.711	0.701	0.709

Table 3-4: 1990-1995 Regression Result (88 Samples

Independent Variable	(1)	(2)	(3)	(4)
Constant Term	0.194 ***	0.208 ***	0.156 **	0.172 ***
	(3.093)	(3.510)	(2.512)	(2.909)
Complexity	-0.228 ***	-0.227 ***	-0.193 **	-0.195 ***
	(-3.055)	(-3.218)	(-2.615)	(-2.788)
Labor Growth	0.188 **	0.187 **	0.180 **	0.180 **
	(2.501)	(2.579)	(2.434)	(2.504)
Capital Growth	0.024	0.029	0.052	0.055
	(0.637)	(0.770)	(1.483)	(1.511)
Materials Input Growth	0.459 ***	0.437 ***	0.441 ***	0.423 ***
	(3.643)	(3.460)	(3.488)	(3.338)
Durability	-	-0.052 **	-	-0.047 **
		(-2.291)		(-2.028)
Debt Burden	-	-	0.008 ***	0.007 ***
			(4.091)	(4.285)
Adjusted R Squared	0.545	0.561	0.566	0.577

Note: *t*-statistics, shown in parentheses, were calculated using heteroskedastic-consistent estimates for the standard errors, that are corrected for the degrees of freedom following Davidson and MacKinnon (1997).
*** significant at the one percent level, ** at the five percent level, * at the ten percent level.

Table 4

Dependent Variable: Capital Growth

Independent Variable	1975-1980	1980-1985	1985-1990	1990-1995
Constant Term	0.255 ***	1.169	0.377 ***	0.050 ***
	(6.681)	(1.459)	(7.562)	(1.518)
Debt Burden	0.003	-0.179	-0.035	-0.020 ***
	-0.582	(-1.462)	(-0.616)	(-3.745)
Adjusted R Squared	-0.013	-0.011	-0.006	0.035
Number of Samples	74	84	86	88

Note: See notes to Table 3.